

METHODS AND SYSTEMS FOR MOBILE APPLICATION PART (MAP)
SCREENING

AN APPLICATION
FOR UNITED STATES LETTER PATENT

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Description

METHODS AND SYSTEMS FOR MOBILE APPLICATION PART (MAP) SCREENING

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Related Applications

This application claims the benefit of United States Provisional Patent
Application Number 60/187,443, filed March 7, 2000, the disclosure of which
10 is incorporated herein by reference in its entirety.

Technical Field

The present invention relates generally to methods and systems for
screening signaling system 7 (SS7) messages. More particularly, the
15 present invention relates to methods and systems for performing mobile
application part (MAP) screening of SS7 messages.

Background Art

In conventional SS7 networks, message screening can occur at signal
20 transfer points (STPs) in order for the service provider that owns the STP
and the associated network to control access to the network. For example, a
service provider may desire to only pass SS7 signaling messages that are
from another service provider with which the first service provider has an
agreement. Another example in which screening may be desirable is when
25 a service provider wishes to block certain types of traffic, such as SPAM
SMS (Short Message Service) messages, from entering the network. Yet
another example in which it may be desirable to screen incoming SS7
messages is when the messages request information regarding the service
provider's subscribers. In this example, it may be desirable to block such

queries, charge a fee for the queries, or only allow queries of a certain type or from an authorized destination.

Screening of incoming SS7 messages at an STP has traditionally been performed at the message transfer part (MTP) or the signaling connection control part (SCCP) level. While screening at the MTP or SCCP levels may be effective for controlling traffic to or from a particular node, such screening does not effectively allow screening based on upper layer protocols in messages, such as MAP protocols.

MAP messages are SS7 messages that reside on top of the transaction capabilities application part (TCAP) and SCCP protocol layers. MAP messages carry services used by mobile telephone subscribers, such as anytime interrogation (ATI) service and short message service (SMS). Anytime interrogation service is a service in which queries can be sent from SS7 service control points (SCPs) to home location registers (HLRs) to determine information regarding mobile subscribers. It may be desirable for the owner of the HLR to identify ATI messages and determine whether the requester should be given access to the information. Similarly, it may be desirable to identify and police SMS messages so that subscribers and/or service providers can be charged for SMS message delivery.

Identifying and policing higher level protocol messages, such as MAP messages, is difficult, if not impossible using conventional gateway and SCCP screening alone because these functions work only on lower layer information. Accordingly, there exists a long-felt need for novel methods and systems for mobile application part (MAP) message screening.

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Summary of the Invention

Methods and systems for mobile application part message screening include a switching node having a mobile application part screening module. The mobile application part screening module includes a mobile application part screening process for receiving an incoming SS7 message including mobile application part layer information. The mobile application part screening module reads at least some of the mobile application part layer information and determines whether to route the message based on the mobile application part information.

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The methods and systems for performing mobile application part screening are described herein as processes, functions, and modules. It is understood that these processes, functions, and modules may be implemented in hardware, software, or a combination of hardware and software. For example, the mobile application part screening module may include a printed circuit board, a microprocessor, and memory for storing programs for performing MAP and SCCP screening.

Accordingly, it is an object of the present invention to provide novel methods and systems for performing mobile application part message screening.

Brief Description of the Drawings

Figure 1 is a block diagram of a telecommunications network in which a signaling gateway having a mobile application part screening module passes a mobile application part query according to an embodiment of the present invention;

Figure 2 is a block diagram of a telecommunications network in which a signaling gateway having a mobile application part screening module does not pass a mobile application part query according to an embodiment of the present invention;

Figure 3 is a block diagram illustrating a signaling gateway having a mobile application part screening module according to an embodiment of the present invention;

Figure 4 is a flow chart illustrating mobile application part message screening performed by the signaling gateway illustrated in Figure 3;

Figure 5 is a block diagram of a telecommunications network including a billing system operatively associated with a signaling gateway having a mobile application part screening module according to an embodiment of the present invention; and

Figure 6 is a block diagram of a telecommunications network including a short message service center and a billing system operatively associated with a signaling gateway having a mobile application part screening module according to an embodiment of the present invention.

Detailed Description of the Invention

Figure 1 is a block diagram of a telecommunications network including a signaling gateway having a mobile application part screening module according to an embodiment of the present invention. In Figure 1, telecommunications network **100** includes signaling gateway **102** having a mobile application part screening module **103**. Signaling gateway **102** may include SS7 signal transfer point functionality for processing SS7 messages and internet protocol (IP) functionality for processing internet protocol messages. In a preferred embodiment, signaling gateway **102** comprises an Eagle® SS7/IP gateway available from Tekelec, Inc., of Calabasas, California. Details of the operation of signaling gateway **102** will be discussed below.

In the illustrated embodiment, SS7/IP gateway **102** includes MAP screening module **103** for screening mobile application part messages. MAP screening module **103** includes hardware and software for identifying mobile application part messages and screening the messages based on one or more mobile application part parameters. Example screening functions performed by MAP screening module **102** will also be discussed in more detail below.

Telecommunications network **100** also includes service control point (SCP) **104**, gateway mobile switching center (GMSC) **106**, and home location registers (HLRs) **110**, **112**, and **114**. Service control point **104** is an SS7 database node that in conventional SS7 networks provided information in response to queries from other nodes. In the illustrated embodiment, SCP **104** also includes the capability for formulating MAP queries, such as anytime interrogation queries, to obtain information from other nodes. GMSC **106** is a switching node that resides at the edge of a mobile network to send messages to and receive messages from other networks.

HLRs **110**, **112**, and **114** are databases used to store subscriber information within the home service area of a GSM provider. Functionally, HLRs **110**, **112**, and **114** are linked to other service areas such that subscriber information is efficiently shared between geographically diverse networks, a characteristic that facilitates seamless internetwork roaming of

mobile subscribers. However, because HLRs **110**, **112**, and **114** contain information regarding mobile subscribers, it may be desirable for the owner of the subscriber information to regulate access to the subscriber information. It is this regulation that is enabled by the mobile application part screening according to embodiments of the present invention.

One example in which it may be desirable to perform mobile application part screening to control access to subscriber information stored in HLRs **110**, **112**, and **114** is when a MAP query, such as an ATI query, is received from an SCP owned by another service provider. In the illustrated embodiment, SCP **104** formulates a MAP query and sends the MAP query to signaling gateway **102** through GMSC **106**. Since it is not desirable to perform MAP screening on every message that arrives at signaling gateway **102**, signaling gateway **102** uses SCCP layer screening to filter messages for which it is not desirable to perform MAP screening. For example, if it is desirable to screen anytime interrogation messages that originate from SCPs, SCCP layer screening may be performed to eliminate from consideration mobile application part screening messages that are not from SCPs. SCCP layer screening may also be used to eliminate from consideration MAP screening messages that are not directed to protected information. If none of the SCCP layer screening eliminates the message from consideration for MAP screening, then MAP screening is performed on the message. MAP screening may include reading one or more MAP parameters in the message to determine whether the message is of a type for which screening is desired. For example, if the message is an anytime interrogation message, it may be desirable to screen the message. Finally, SCCP layer screening may be used to screen MAP messages that are from unauthorized nodes, i.e., nodes that are not permitted to access the desired resource. Thus, by using SCCP layer screening in combination with MAP screening, regulation of access to protected network information, such as mobile subscriber information, may be efficiently performed.

In Figure 1, the MAP query is assumed to have passed all SCCP and MAP screening processes. Accordingly, the query is passed to HLR **110**. HLR **110** responds with the requested subscriber information, and the response to the query follows the same path as the query. For an anytime

interrogation query, the response may contain the location and/or status of a mobile subscriber. Thus, the result of MAP and SCCP screening in Figure 1 is the passing of a query to its intended destination.

The telecommunications network illustrated in Figure 2 is the same network illustrated in Figure 1. However, in Figure 2, the MAP query is assumed not to pass one of the screening processes. For example, the MAP query from SCP **104** may be an ATI query requesting mobile subscriber information from HLR A **110**. When SG **102** receives the query, SG **102** may analyze SCCP information in the query to determine that the query is from an SCP and that the query is addressed to HLR A **110**, which contains limited access subscriber information. Since the SCCP information indicates that further inquiry is required, MAP screening module **103** may then read the MAP level information to determine if the message is of a type for which authorization is required. In this example, it is assumed that the query is an ATI query and that authorization is required. Accordingly, after identifying the message as an ATI query, MAP screening module determines whether the message is from an authorized user based on SCCP information in the message. In Figure 2, it is assumed that the user is not an authorized user. As a result, MAP screening module formulates a MAP error message and sends the MAP error message to SCP **104** through GMSC **106**. In an alternative example, MAP screening module **103** may permit access to only some of the requested information in HLR **110**.

Figure 3 illustrates the internal subsystems of signaling gateway **102**, including MAP screening module **103**, in more detail. In the illustrated embodiment, signaling gateway **102** includes link interface module **308** for sending and receiving SS7 messages over SS7 links. LIM **308** includes of a number of sub-components including, but not limited to: an SS7 MTP level 1 and 2 process **310**, an I/O buffer or queue **312**, HMDC process **314**, and HMDT process **316**. MTP level 1 and 2 process **310** provides the facilities necessary to send and receive digital data over a particular physical media / physical interface, as well as to provide error detection / correction and sequenced delivery of all SS7 message packets. I/O queue **312** temporarily buffers incoming and outgoing SS7 messages. HMDC process **314** performs a discrimination function for determining whether an incoming SS7

message packet requires internal processing or is simply to be through switched, i.e., routed to another node. HMDT process **316** handles internal routing of SS7 message packets that require additional processing prior to final routing.

5 Interprocessor message transport (IMT) bus **304** provides a reliable transport mechanism for transporting messages between modules in signaling gateway **102**. In a preferred embodiment, IMT bus **304** comprises a dual counter-rotating bus so that traffic can be re-routed in response to a module failure.

10 MSM module **103** performs SCCP and MAP screening functions on messages received from LIM **308** and DCM **336**. In the illustrated embodiment, MSM module **103** includes SCCP screening process **326** for performing SCCP screening functions on incoming messages, MAP screening process **328** for performing MAP screening of incoming
15 messages, global title translation process **330** for performing global title translation of incoming messages, and HMRT function **332** for routing messages after screening and/or global title translation has been performed.

Although not illustrated in Figure 3, it is understood that SCCP screening process **326** may access one or more internal or external SCCP screening databases, MAP screening process **328** may access one or more
20 internal or external MAP screening databases, and GTT process **330** may access one or more internal or external GTT databases. In order to maintain the databases, MSM **103** is coupled to and serviced by an OAM subsystem **335** via an Ethernet connection **333**. OAM subsystem **335** is responsible for
25 administration and maintenance of the databases.

Data communication module (DCM) **336** is adapted to convert incoming IP-encapsulated SS7 messages into SS7 format and encapsulate outgoing SS7 messages in IP packets. In the illustrated embodiment, DCM
30 **336** includes an HMCG process **340** that is responsible for monitoring congestion on the associated DCM linksets, and internally communicating this link congestion information to peer processes on other modules via IMT bus **304**. The link congestion information is used by the HMRT function **332** during outbound link selection operations. It should be appreciated that outgoing SS7 message packets routed through the DCM **336** will be

transmitted out of the signaling gateway **102** and into an Internet Protocol (IP) network **108**.

As the SS7 communication protocol and the IP communication protocol are not inherently compatible, all SS7 message packets that are to be sent into the IP network **108** are first encapsulated within an IP routing envelope prior to transmission over the IP network and decapsulated before being transmitted over the SS7 network. This IP encapsulation and decapsulation is performed by an IP encapsulation/decapsulation process **342**. IP encapsulation/decapsulation process **342** is the IP protocol equivalent of the SS7 MTP level 1-2 layer process **310** of the LIM **308**. Preferred packet formats for encapsulating and decapsulating various types of SS7 messages in IP packets is described in Internet Engineering Task Force (IETF) INTERNET DRAFT: Transport Adapter Layer Interface, <draft-benedyk-sigtran-tali-01.txt>, June 2000, the disclosure of which is incorporated herein by reference in its entirety. The TALI protocol is also described in commonly-assigned co-pending international patent publication no. WO/761434 A1, published December 14, 2000, the disclosure of which is incorporated herein by reference in its entirety. In addition to or alternatively to the TALI protocol, IP encapsulation/decapsulation process **342** may implement one or more SS7 user adaptation layers, such as the SS7 SCCP user adaptation (SUA) layer or the SS7 MTP3 user adaptation (M3UA) layer, and the stream control transmission protocol (SCTP). The SUA protocol is described in IETF Internet Draft: SS7 SCCP-User Adaptation Layer (SUA), <draft-ietf-sigtran-sua-05.txt>, February 2001, the disclosure of which is incorporated herein by reference in its entirety. The M3UA protocol is described in IETF Internet Draft: SS7 MTP3-User Adaptation Layer (M3UA), <draft-ietf-sigtran-m3ua-06.txt>, February 2001, the disclosure of which is incorporated herein by reference in its entirety. The stream control transmission protocol is described in IETF RFC 2960: Stream Control Transmission Protocol, October, 2000, the disclosure of which is incorporated herein by reference in its entirety.

MAP AND SCCP SCREENING

Figure 4 is a flow chart illustrating exemplary steps that may be performed by the processes illustrated in Figure 3 for performing MAP and SCCP screening functions. In step **ST1**, LIM 308 receives an SS7 message signal unit (MSU). In step **ST2**, MTP level 1 and 2 process 310 performs MTP level 1 and 2 processing on the incoming message. In step **ST3**, HMDC function 314 performs message discrimination, e.g., by examining the destination point code or other fields, in the message to determine whether the message is to be internally routed or through switched. In this example, it is assumed that the message is to be internally routed.

In step **ST4**, gateway screening is performed on the incoming message, for example, to determine whether the message is from an allowed OPC or has an allowed SIO value. In this example, it is assumed that the message passes the gateway screening process.

In step **ST5**, HMDT process 316 routes the message to the appropriate internal address for further processing. In this example, HMDT process 316 routes the message to MSM module 103 for further processing. Once MSM module 103 receives the message, in step **ST6** SCCP screening process 326 screens the message based on the subsystem number (SSN) in the calling party address field of the message to determine whether the message is from a targeted node type. By "targeted node type" it is meant that the message is examined to determine whether the originating node is of a type for which it may be desirable to perform MAP screening. For example, it is known that anytime interrogation messages originate from SCPs. Accordingly, SCCP screening process 326 may be provisioned to determine that all queries received from SCPs are from targeted node types.

In step **ST7**, if SCCP screening process 326 determines that the message is from a targeted node type, in step **ST8**, SCCP screening process 326 examines the SSN value in the called party address field to determine whether the message is directed to a targeted node type. In this step, the destination node type is examined to determine whether it is of a type for which MAP screening may be desired. For example, it is known that anytime interrogation messages are directed to HLRs. In step **ST9**, if the

SSN in the called party address field indicates that the message is directed to an HLR, the screening process continues.

In step **ST10**, MAP screening process **328** performs MAP screening on the message by examining the opcode field in the MAP portion of the message to determine the MAP message type and whether the message is of a type targeted for screening. Continuing with the present example, if the message is an anytime interrogation message, the message may be of a type targeted for screening. Accordingly, in step **ST11**, if it is determined that the MAP message type is of a type targeted for screening, in steps **ST12** and **ST13**, SCCP authorization screening is performed on the message to determine whether the originator of the message is authorized to make the requested inquiry. The originator of the message may be identified by examining the SCCP calling party address field in the message. For example, one service provider may have an agreement with another service provider to allow the first service provider to make anytime interrogation queries to the second service provider's HLRs. If this is the case, the query may be allowed to pass. If not, in step **ST14**, an error message may be sent to the service provider from which the query originated.

In step **ST15**, if the originator is authorized to make the query, SCCP screening process **326** passes the query to GTT process **330** to undergo global title translation. After performing global title translation on the message, GTT process **330** passes the message to HMRT process **332**, which routes the message to the appropriate outgoing address on LIM **308** or DCM **336**. The result of failing one of the SCCP or MAP screening procedures in steps **ST7**, **ST9**, and **ST11** is the same as passing all screening in step **ST13**, i.e., the message is routed to the intended destination because it is either not of a type for which authorization is required or it is of such a type and the user is authorized to make the query.

MAP-Based Billing System

Figure 5 illustrates an alternative embodiment of the invention in which a MAP billing system **500** is operatively associated with signaling gateway **102**. For example, MAP billing system **500** may comprise software residing on a computer located external to signaling gateway **500**.

Alternatively, MAP billing system **500** may comprise hardware, such as a card, and software located internal to signaling gateway **102** to perform MAP-based billing.

One example of MAP based billing according to the present embodiment is to bill service providers based on the number of MAP queries that pass the screening process. For example, if a service provider is authorized to make anytime interrogation queries to another service provider's HLRs, it may be desirable to bill the querying service provider based on the number of successful MAP queries to the HLR. When MAP screening module **103** allows a query to pass, MAP screening module **103** may send a copy of all or part of the parameters to MAP billing system **500**. MAP billing system may create a MAP billing record for the message. An example of such a record is as follows:

CgPA SSN	CdPA SSN	MAP Opcode	CgPA	Count	Interval
Value for SCP	Value for HLR	Value for ATI	Call Party Numbering Plan Address	Number of Queries	Time Interval

In the example record, the CgPA and CdPA SSN fields store codes indicative of node types. The MAP opcode field stores the value for the MAP opcode of a successful message. CgPA field stores the numbering plan address of the originator. The count field stores the number of queries made with these field values. Finally, the interval field store the time interval for which the count applies. For example, the first time a given node makes a query to a given HLR, a record is created. The next time the same node makes a successful query to the same HLR, the count value in the previous field is updated. The record in the table shown above may be used to bill a calling party or a service provider based on the number of queries made that match the values in the table.

Figure 6 illustrates yet another alternative embodiment of the present message in which a MAP billing system **500** and a short message service center (SMSC) **600** are operatively associated with signaling gateway **102**.

In the network illustrated in Figure 6, it may be desirable to charge other service providers for the use of SMSC **600** to forward short messages. For example, a mobile station, i.e., a handset, from another network may send a forward short message (FSM) message to SMSC **600**. In the illustrated embodiment, handset **602** originates a short message. The short message is received by mobile receiving site **603**. Base station controller/base transceiver station pair (BSC/BTS) **604** receives the short message and forwards the message to GMSC **103**. GMSC **103** forward a FSM message to SG **102**. MAP screening module **103** in signaling gateway **102** may perform MAP and SCCP screening functions, as described above. If the FSM message passes one or more SCCP and/or MAP based screening criteria, the message may be routed to SMSC **600**. MAP billing system **500** may generate billing records based on the number of FSM messages that are routed to SMSC **600**. Thus, the present embodiment provides a mechanism for billing based on mobile-originating SMS messages.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.